US009016175B2

(12) **United States Patent**
Wu

(10) **Patent No.: US 9,016,175 B2**
(45) **Date of Patent: Apr. 28, 2015**

(54) **CLUTCH FOR TORQUE-EXERTING DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 332 days.

(21) Appl. No.: **13/604,603**

(22) Filed: **Sep. 5, 2012**

(65) **Prior Publication Data**

US 2014/0060270 A1 Mar. 6, 2014

(51) **Int. Cl.**
B25B 23/157 (2006.01)
B25B 23/142 (2006.01)

(52) **U.S. Cl.**
CPC ***B25B 23/1427*** (2013.01)

(58) **Field of Classification Search**
CPC B25B 23/1427; B25B 23/1422; B25B 23/142; B25B 23/141; B25B 15/02; F16D 7/044
USPC 81/52, 467, 473–476, 478, 480; 73/862, 73/862.08
See application file for complete search history.

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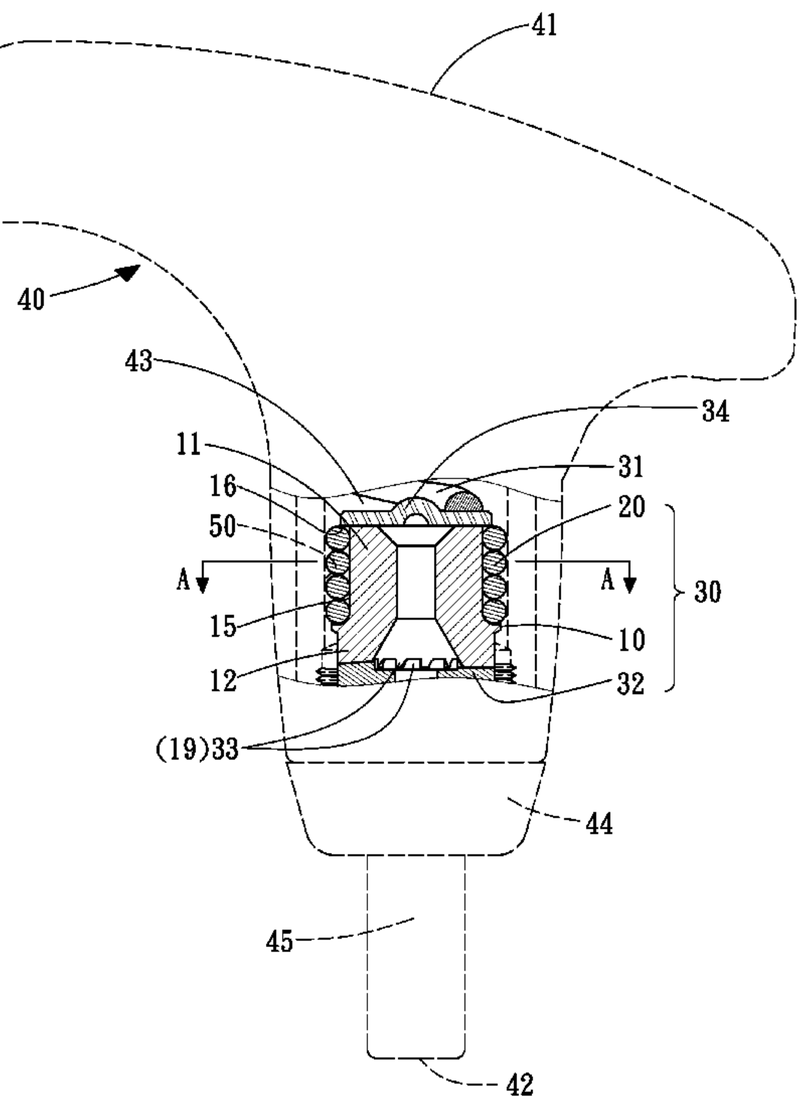
(57) **ABSTRACT**

A torque-exerting device includes a clutch arranged between a handle and an axle. The handle includes a chamber defined therein by a wall. The clutch includes a movable element, a rotatable element, recesses and balls. The movable element is placed in the chamber in an axially movable manner. The rotatable element is placed in the chamber in a rotatable manner and secured to the axle. The rotatable element is in releasable engagement with the movable element. The recesses are defined in the movable element or the wall of the chamber of the handle. Each of the balls is partially placed in a respective one of the recesses and in contact with the wall of the chamber of the handle or the movable element.

15 Claims, 7 Drawing Sheets



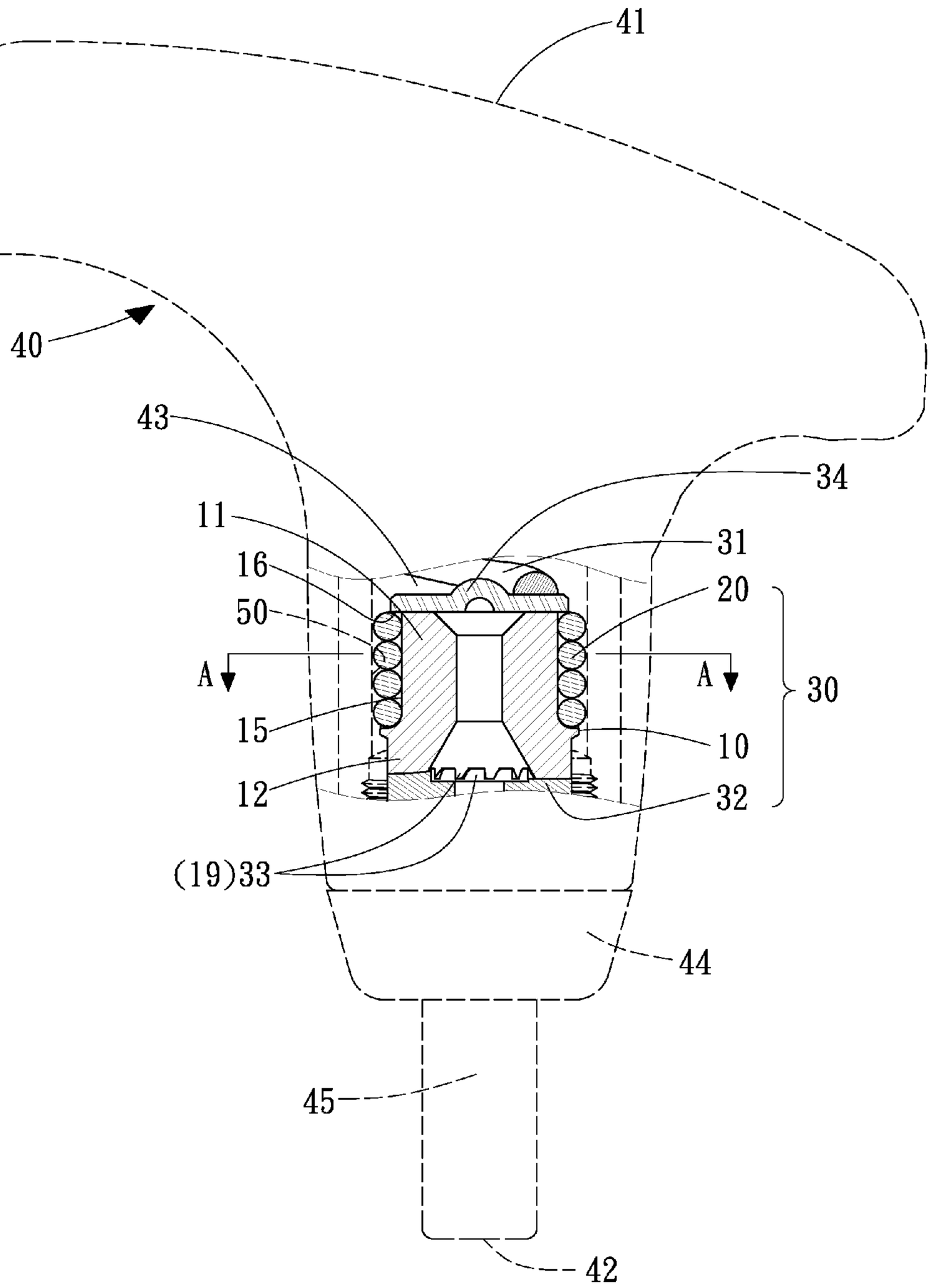


FIG. 1

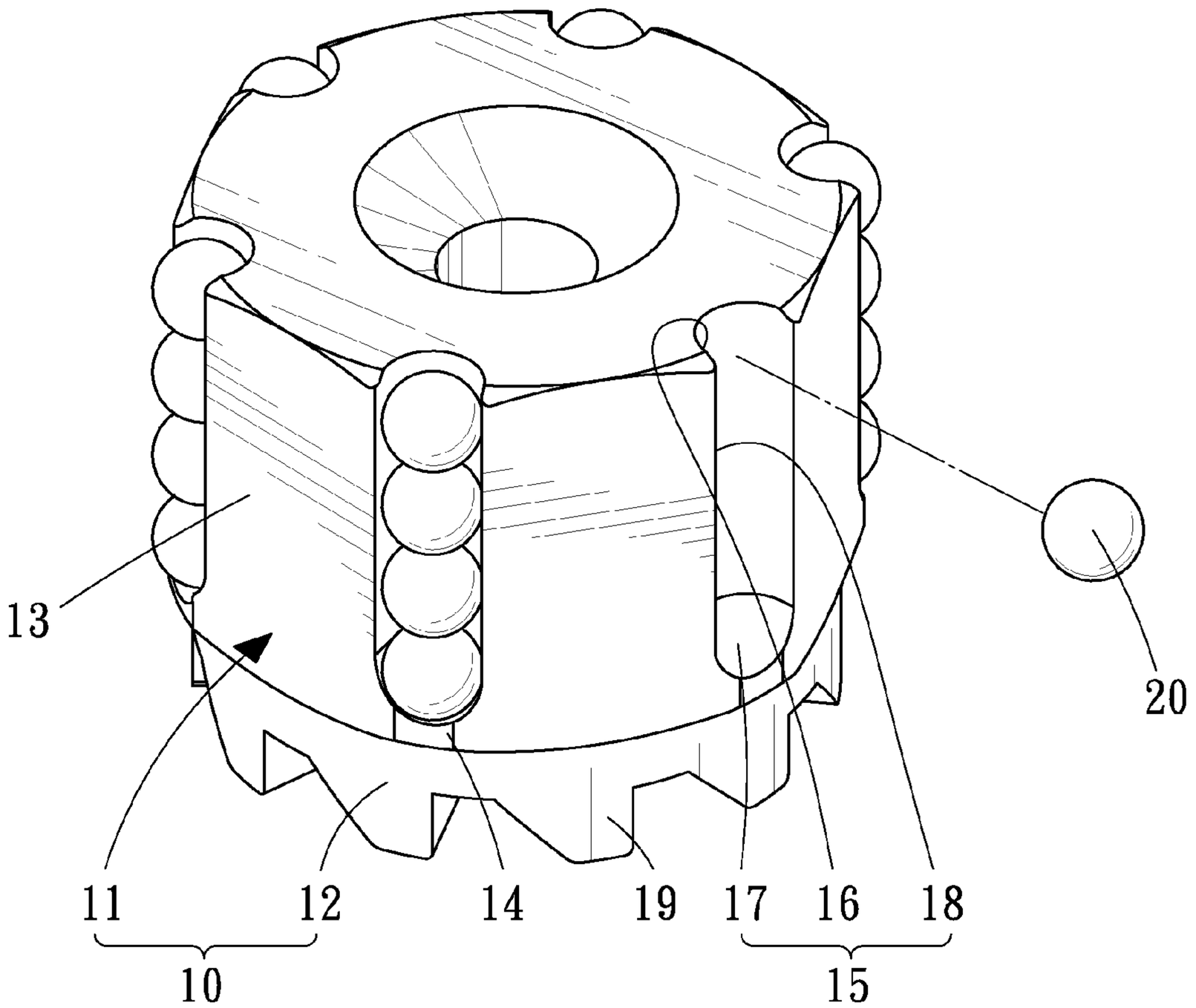


FIG. 2

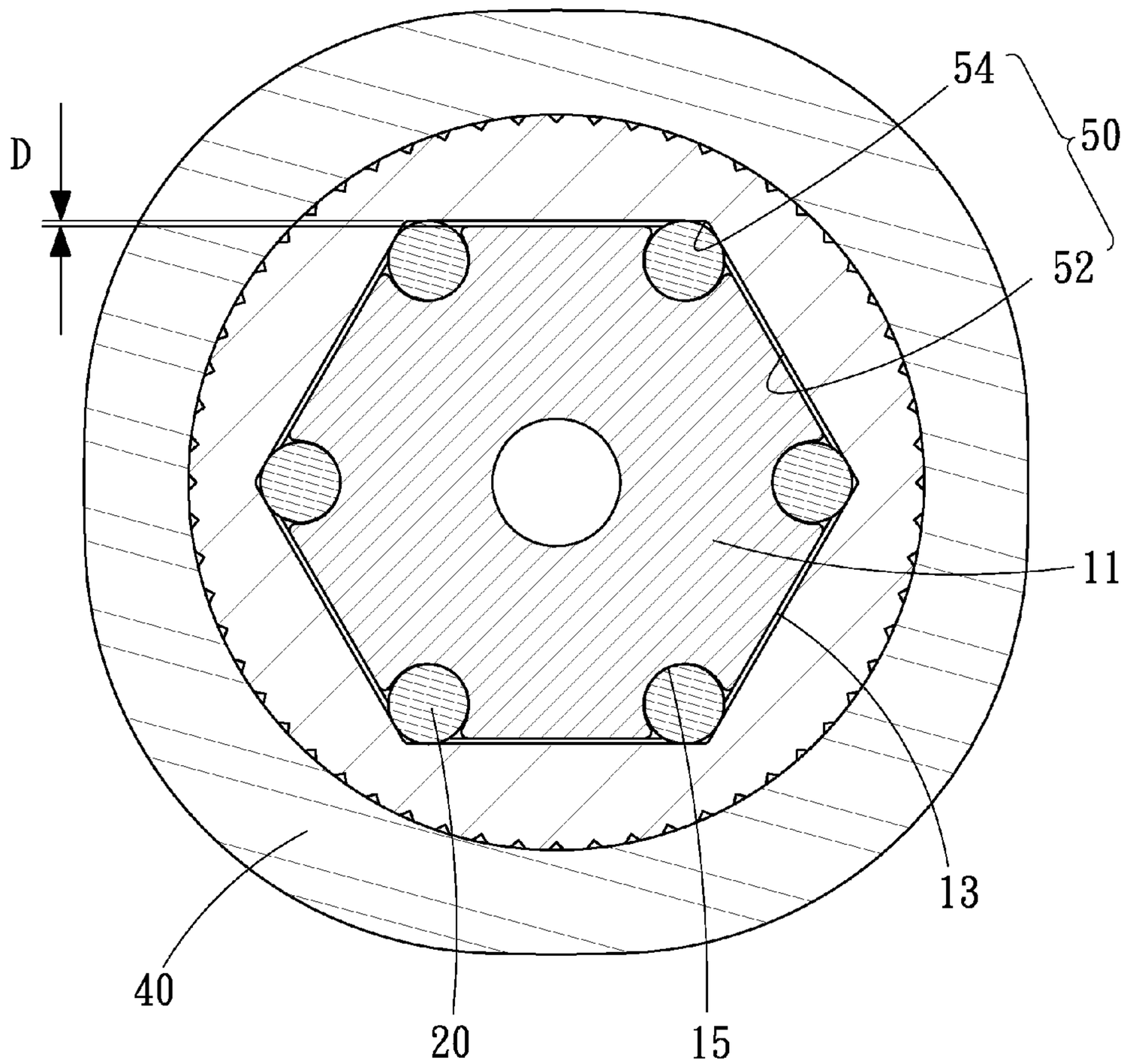


FIG. 3

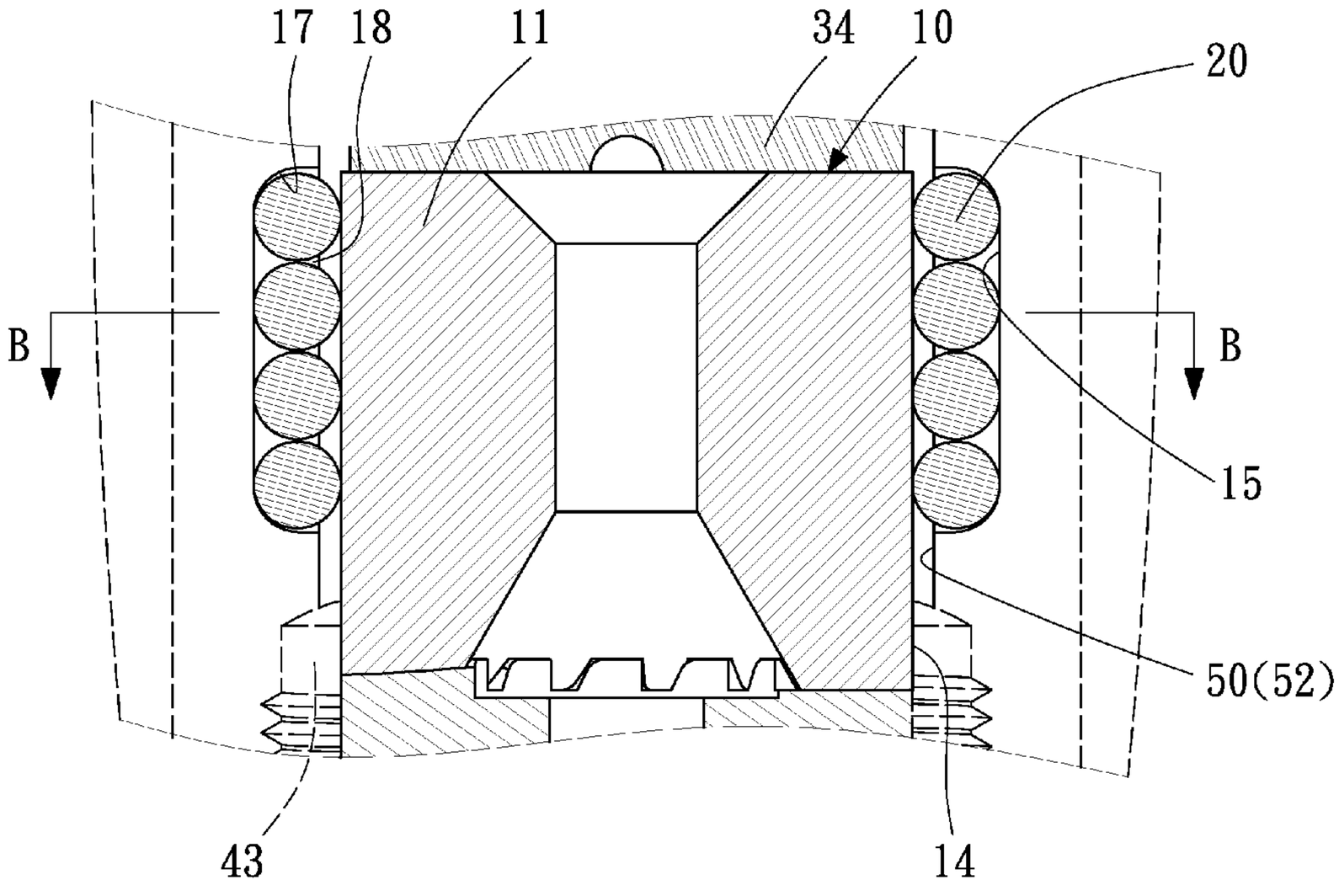


FIG. 4

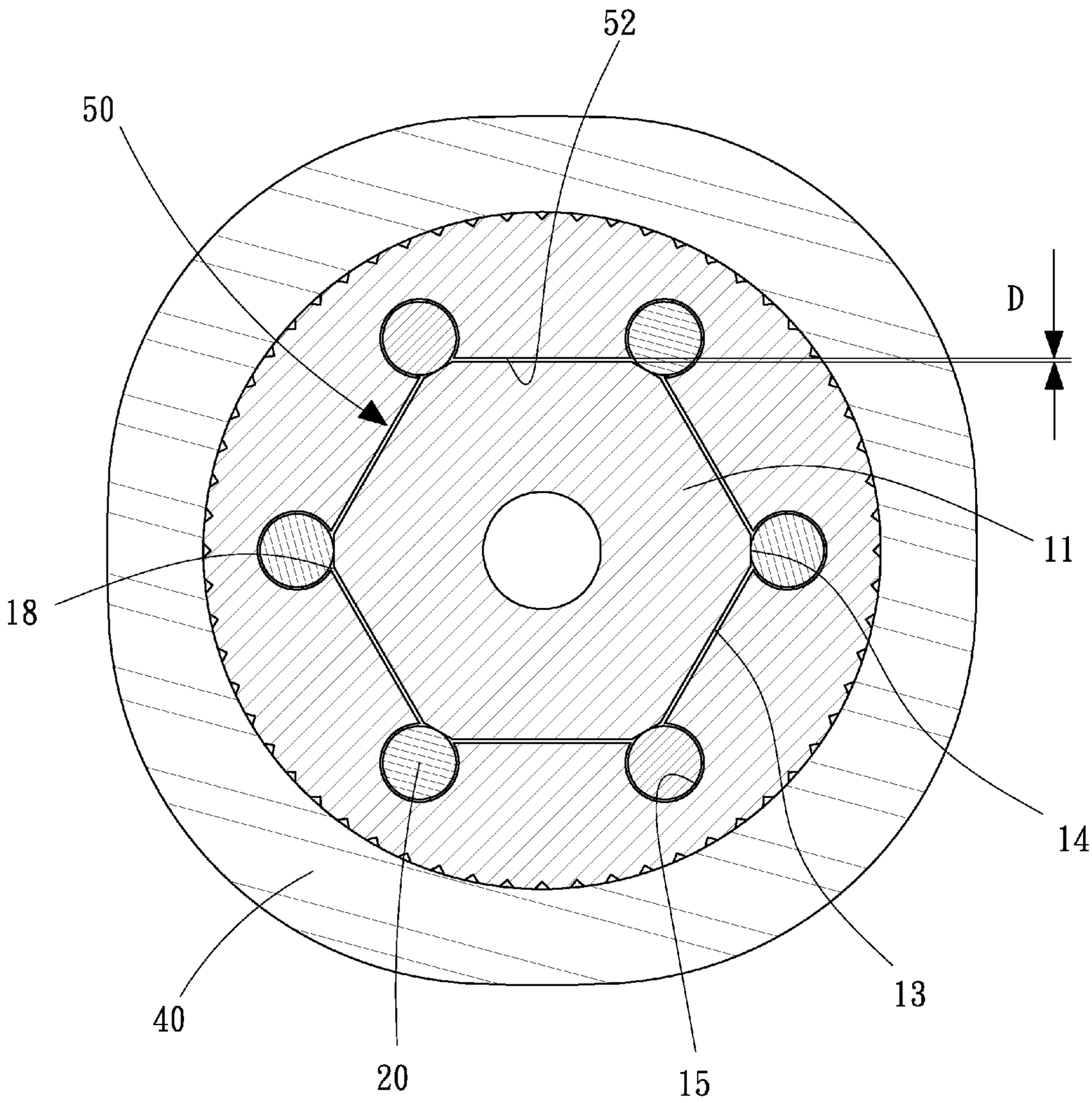


FIG. 5

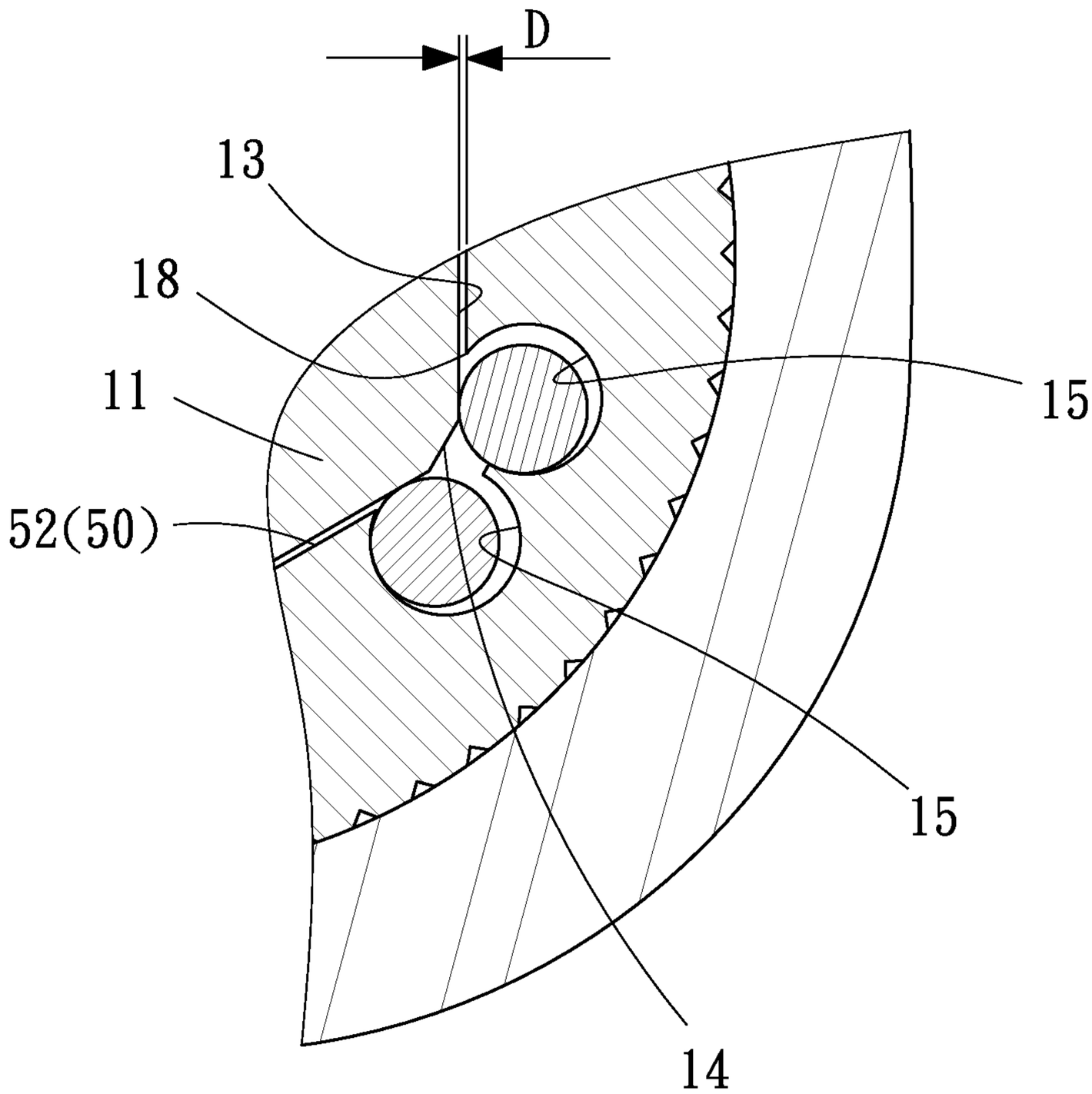


FIG. 6

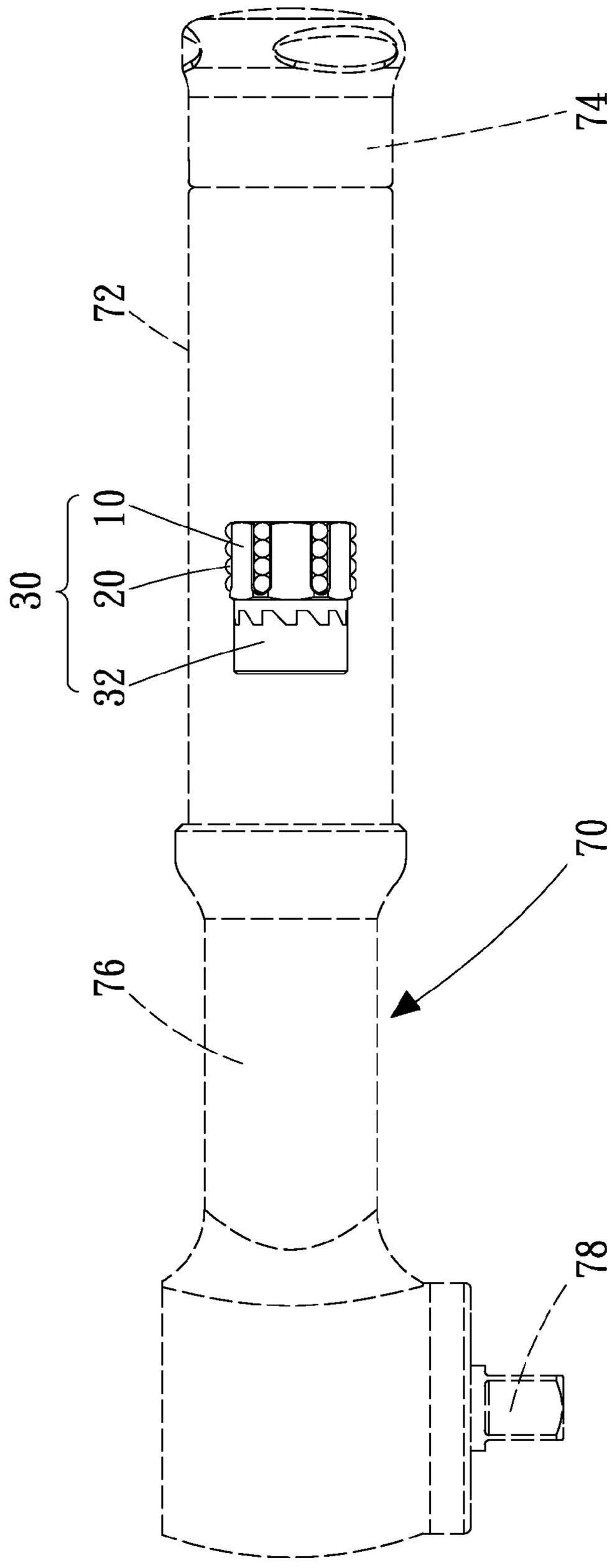


FIG. 7

CLUTCH FOR TORQUE-EXERTING DEVICE

BACKGROUND OF INVENTION

1. Field of Invention

The present invention relates to a torque-exerting device and, more particularly, to a clutch for a torque-exerting device.

2. Related Prior Art

There are various torque-exerting devices such as screwdrivers and wrenches. These torque-exerting devices can be classified into hand tools and automatic tools. The automatic tools can be classified into pneumatic and electric tools. Some of the torque-exerting devices include clutches to transmit predetermined values of torque.

The clutches can be classified into a ratchet-type and a ball-type. A ratchet-type of clutch includes a movable element and a rotatable element. The movable element includes ratchets for releasable engagement with ratchets of the rotatable element. In use, the movable element is placed in a handle for example so that the former is movable up and down in the latter. The rotatable element is placed in the handle so that the former is rotatable in the latter. The rotatable element is engaged with a bit. A predetermined value of torque can be transferred to the bit from the handle via the clutch. Under the predetermined value of torque, the ratchets of the movable element are engaged with the ratchets of the rotatable element for transmitting the torque. At the predetermined value of torque, the ratchets of the movable element are disengaged from the ratchets of the rotatable element. When the ratchets of the movable element are disengaged from the ratchets of the rotatable element, the movable element is moved up and down in the handle. The movable element tends to wear away the handle.

The present invention is therefore intended to obviate or at least alleviate the problems encountered in prior art.

SUMMARY OF INVENTION

It is the primary objective of the present invention to provide a torque-exerting device with a durable clutch.

To achieve the foregoing objective, the clutch is arranged between a handle and an axle of the torque-exerting device. The handle includes a chamber defined therein by a wall. The clutch includes a movable element, a rotatable element, recesses and balls. The movable element is placed in the chamber in an axially movable manner. The rotatable element is placed in the chamber in a rotatable manner and secured to the axle. The rotatable element is in releasable engagement with the movable element. The recesses are defined in the movable element or the wall of the chamber of the handle. Each of the balls is partially placed in a respective one of the recesses and in contact with the wall of the chamber of the handle or the movable element.

In another aspect, the handle includes a chamber and at least one recess. The chamber is defined by a wall. The recess is defined in the wall of the chamber of the handle. The clutch includes a movable element, a rotatable element and at least one ball. The movable element is placed in the chamber in an axially movable manner. The rotatable element is placed in the chamber in a rotatable manner and secured to the axle. The rotatable element is in releasable engagement with the movable element. The ball is partially placed in the recess and partially in contact with the movable element.

Other objectives, advantages and features of the present invention will be apparent from the following description referring to the attached drawings.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described via detailed illustration of four embodiments referring to the drawings wherein:

FIG. **1** is a cross-sectional view of a torque-exerting device equipped with a clutch according to the first embodiment of the present invention;

FIG. **2** is a perspective view of a movable element of the clutch shown in FIG. **1**;

FIG. **3** is a cross-sectional view of the torque-exerting device taken along a line A-A shown in FIG. **1**;

FIG. **4** is a cross-sectional view of a torque-exerting device equipped with a clutch according to the second embodiment of the present invention;

FIG. **5** is a cross-sectional view of the torque-exerting device equipped taken along a line B-B in FIG. **4**;

FIG. **6** is a cross-sectional view of a torque-exerting device equipped with a clutch according to the third embodiment of the present invention; and

FIG. **7** is a cross-sectional view of a torque-exerting device equipped with a clutch according to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Referring to FIG. **1**, a torque-exerting device **40** includes a clutch **30** arranged between a handle **41** and an axle **45** according to a first embodiment of the present invention. The torque-exerting device **40** is a screwdriver in accordance with the first embodiment. In use, the axle **45** is engaged with a bit. A predetermined value of torque can be transferred to the bit from the handle **41** via the clutch **30**. Under the predetermined value of torque, the handle **41** is engaged with the axle **45** via the clutch **30** for transmitting the torque. At the predetermined value of torque, the handle **41** is disengaged from the axle **45** via the clutch **30**. The handle **41** includes a chamber **43** defined therein for holding the clutch **30**. Referring to FIG. **3**, the chamber **43** is defined by a polygonal wall **50**. The polygonal wall **50** is preferably a hexagonal wall that includes six facets **52** alternately arranged with six corners **54**.

The clutch **30** includes a movable element **10**, a rotatable element **32**, a spring **31**, a plurality of balls **20** and a cover **34**. As best shown in FIG. **2**, the movable element **10** includes a hexagonal portion **11**, a circular portion **12** coaxially extending from the hexagonal portion **11**, and ratchets **19** longitudinally extending from the circular portion **12**. The ratchets **19** are arranged along a circle at a free end of the circular portion **12** of the movable element **10**.

The hexagonal portion **11** of the movable element **10** namely includes six facets **13** alternately arranged with six corners **14**. The distance between any two opposite ones of the facets **13** is longer than the diameter of the circular portion **12** of the movable element **10**. The hexagonal portion **11** of the movable element **10** further includes six recesses **15** each defined in a respective one of the corners **14**. Each of the recesses **15** is preferably a groove that includes an open end **16**, a closed end **17**, and an opening **18** extending to the open end **16** from the closed end **17**.

At least one of the balls **20** is placed in each of the recesses **15**. Four of the balls **20** are placed in each of the recesses **15** preferably. The diameter of the balls **20** is marginally shorter than the diameter of the recesses **15** so that the former can be

placed in the latter. Each ball **20** is partially placed in the respective recess **15** and partially placed out of the respective recess **15**.

The diameter of the balls **20** may be shorter than or identical to the width of the openings **18** so that the former can be moved into the recesses **15** via the latter. The diameter of the balls **20** may be longer than the width of the openings **18** so that the former cannot be moved through the latter and that the balls **20** are moved into the recesses **15** via the open ends **16**.

Each ball **20** includes a portion in contact with a concave face that defines the respective recess **15** and two other portions in contact with two adjacent facets **52** of the polygonal wall **50**. Hence, each facet **13** is separated from the respective facet **52** by a gap D.

The rotatable element **32** includes a plurality of ratchets **33** longitudinally extending from an upper end. The ratchets **33** are arranged along a circle at the upper end of the rotatable element **32**. The ratchets **33** are used for releasable engagement with ratchets **19**.

In assembly, the spring **31** and the cover **34** are placed in the chamber **43**. The movable element **10** and the balls **20** are placed in the chamber **43** so that the former are movable up and down in the latter. The balls **20** are kept in the recesses **15** by the cover **34**. The movable element **10** is biased by the spring **31** via the cover **34**. The rotatable element **32** is placed in the chamber **43** so that the former is rotatable in the latter. An upper end of the axle **45** is connected to the rotatable element **32**. A ring **44** is attached to the handle **41**, thus keeping the clutch **30** in the handle **41**. A lower end **42** of the axle **45** extends out of the handle **41** via the ring **44**. The rotatable element **32** is engaged with a bit.

In use, a predetermined value of torque can be transferred to the bit from the handle **41** via the clutch **30**. Under the predetermined value of torque, the ratchets **19** of the movable element **10** are engaged with the ratchets **33** of the rotatable element **32** for transmitting the torque. At the predetermined value of torque, the ratchets **19** are disengaged from the ratchets **33**. As the ratchets **19** are disengaged from the ratchets **33**, the movable element **10** is moved up and down relative to the rotatable element **32** in the handle **41**. The movable element **10** is however kept from the polygonal wall **50** by the balls **20** that roll on the polygonal wall **50**.

The friction between the balls **20** and the polygonal wall **50** is small. Therefore, the wear of the polygonal wall **50** is mild, and the torque-exerting device **40** is durable.

Referring to FIGS. **4** and **5**, there is shown a torque-exerting device according to a second embodiment of the present invention. The second embodiment is like the first embodiment except that each of the recesses **15** is defined in a respective corner **54** of the polygonal wall **50** of the chamber **43** of the handle **41** instead of a corner **14** of the hexagonal portion **11** of the movable element **10**. Each of the recesses **15** is preferably a groove that includes two closed ends **17** and an opening **18**. Each corner **14** of the polygonal portion of the movable element **10** is chamfered.

Referring to FIG. **6**, there is shown a torque-exerting device according to a third embodiment of the present invention. The third embodiment is like the second embodiment except that two recesses **15**, instead of one, are defined in a respective corner **54** of the polygonal wall **50** of the chamber **43** of the handle **41**. In each corner **54** of the polygonal wall **50** of the chamber **43** of the handle **41**, the openings **18** of the recesses **15** may or may not be overlapped.

Referring to FIG. **7**, there is shown a torque-exerting device according to a fourth embodiment of the present invention. The fourth embodiment is like the first embodiment except being a wrench **70**. The wrench **70** includes a handle **72**, a knob **74**, a head **76** and a tongue **78**. The wrench **70** further includes a transmission mechanism although the latter is not shown. In a first mode of operation, the handle **72** is rotated or pivoted about a vertical axis, i.e., about the tongue **78**. Torque is transferred to the head **76** from the handle **72** and then to the tongue **78** from the head **76** via the transmission mechanism.

In a second mode of operation, the handle **72** is rotated relative to the head **76** about a horizontal axis. Torque is transferred to the transmission mechanism from the handle **72** via the clutch **30** and then to the tongue **78** from the transmission mechanism. In the second mode of operation, the value of the torque cannot exceed a limit set by operating the knob **74**.

The present invention has been described via the detailed illustration of the embodiments. Those skilled in the art can derive variations from the embodiments without departing from the scope of the present invention. Therefore, the embodiments shall not limit the scope of the present invention defined in the claims.

The invention claimed is:

1. A torque-exerting device including:

a handle including a chamber defined therein by a wall;

an axle;

a clutch including:

a movable element placed in the chamber in an axially movable manner;

a rotatable element placed in the chamber in a rotatable manner and secured to the axle, wherein the rotatable element is in releasable engagement with the movable element; and

recesses defined in one of the movable element and the wall of the chamber of the handle; and

balls each partially placed in a respective one of the recesses and in contact with the other of the movable element and the wall of the chamber of the handle.

2. The torque-exerting device according to claim **1**, wherein the recesses are defined in the movable element, wherein the balls are in contact with the wall of the chamber of the handle.

3. The torque-exerting device according to claim **2**, wherein the wall of the chamber of the handle is a polygonal wall with alternate facets and corners, wherein each of the balls is in contact with two adjacent ones of the facets of the wall of the chamber of the handle.

4. The torque-exerting device according to claim **3**, wherein the movable element includes a polygonal portion with alternate facets and corners, wherein each of the recesses is defined in a respective one of the corners of the polygonal portion of the movable element.

5. The torque-exerting device according to claim **1**, wherein the recesses are defined in the wall of the chamber of the handle.

6. The torque-exerting device according to claim **5**, wherein the movable element includes a polygonal portion with alternate facets and corners, wherein each of the balls is in contact with a respective one of the corners of the polygonal portion of the movable element.

7. The torque-exerting device according to claim **6**, wherein the corners of the polygonal portion of the movable element are chamfered.

8. The torque-exerting device according to claim **6**, wherein the wall is a polygonal wall with alternate facets and corners, wherein each of the recesses is defined in a respective one of the corners of the polygonal wall.

9. The torque-exerting device according to claim **6**, wherein the wall is a polygonal wall with alternate facets and

corners, wherein two adjacent ones of the recesses are defined in a respective one of the corners of the polygonal wall.

10. The torque-exerting device according to claim **1**, wherein the clutch further includes a spring for keeping the movable element in engagement with the rotatable element.

11. The torque-exerting device according to claim **1**, wherein each of the recesses includes two closed ends and an opening between the closed ends, wherein the width of the opening is identical to or shorter than the diameter of the ball.

12. The torque-exerting device according to claim **1**, wherein each of the recesses includes an open end, a closed end and an opening between the open and closed ends, wherein the width of the opening is identical to or shorter than the diameter of the ball.

13. The torque-exerting device according to claim **11**, wherein the clutch further includes a cover for closing the open end of the recess.

14. The torque-exerting device according to claim **13**, wherein the clutch further includes a spring for biasing the movable element via the cover.

15. The torque-exerting device according to claim **1**, wherein the movable element further includes ratchets longitudinally extending from an end, wherein the rotatable element includes ratchets in releasable engagement with the ratchets of the movable element.

* * * * *